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LETTER REGARDING SIX REPORTS WRITTEN BY ABB ENVIRONMENTAL ABOUT SITE 11 NSB KINGS BAY GA
2/9/1995
U S DEPARTMENT OF THE INTERIOR

United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
Peachtree Business Center, Suite 130
3039 Amwiler Road
Atlanta, Georgia 30360-2824

TAKE PRIDE IN AMERICA

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NSB Kings Bay Administrative Record
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Mr. Sandi Mukherjee
Environmental Coordinator
Naval Submarine Base
1063 Tennessee Avenue
Kings Bay, Georgia 31547-2606

Dear Mr. Mukherjee;

Six reports written by ABB Environmental Services (ABB) about the site 11 landfill study at Kings Bay submarine base were transmitted from Commander M. J. Patterson to me some time ago. Although they are final versions, and were evidently sent for information rather than review, I have several comments on two of them that the U.S. Navy and ABB might find useful for future descriptions of hydrologic conditions at the site. The comments pertain to reports, both dated July 1994, entitled "Technical Memorandum, 1993 Field Program and January 1994 Groundwater Sampling Event for Site 11, Old Camden County Landfill", and "Interim Measure, Phase 1 Activities: System Installation, Technical Memorandum, Site 11, Old Camden County Landfill".

The comments are mostly about possible misconceptions regarding the nomenclature of geologic strata on the Georgia coast, and the estimated position of the lower confining bed, or lower ground-water flow boundary, at site 11. ABB calls the top of the lower confining bed, which they estimate to be at a depth of about 80 feet below ground level, the top of the Hawthorn Formation. The top of this formation is actually at a depth of about 185 feet at Kings Bay.

The position of the lower confining bed, as estimated by ABB, is evidently based mainly on the results of one core analysis. USGS analysis of the ABB water-level data from several well clusters indicate that some restriction to ground-water flow is about 15 feet shallower, at about -35 to -40 feet altitude (referenced to mean low water) at a depth of about 65-70 feet below ground level near the entrance to the Crooked River Plantation subdivision. The detailed descriptions regarding these comments are on the enclosure.

Two copies of this letter and the enclosure are attached, in case you want to transmit them to Commander Patterson and to ABB. If you need other copies, please let me know. The USGS hopes that these comments are useful to you. If you have any questions, please feel free to call me at (404) 903-9100.

Sincerely,

Bud Zehner

Bud Zehner
Hydrologist

Enclosures

USGS comments on position of confining bed in vicinity of Kings Bay site 11 and on ABB reports of July 1994

Gamma radiation logs of three wells (fig. 1) illustrate the stratigraphy in the Kings Bay area. The Rayland well is located adjacent to Georgia highway spur-40, at the entrance to the Crooked River Plantation subdivision. The USGS logs from the Rayland well were described in a letter to David Driggers, Southern Division Naval Facilities Engineering Command, dated May 23, 1994. The U.S. Navy Observation Well #2 is located on the Kings Bay submarine base, about 1/2 mile east of the visitor's center at the base entrance. The Jiffy well is located in St. Marys, at the intersection of Georgia highway spur-40 and Georgia highway 40.

The ground-level altitude at the Rayland well (fig.1) was measured by leveling methods, and the altitudes of the other two wells were estimated from topographic maps. All altitudes given in this letter are referenced to mean low water. Altitudes on maps are referenced to mean sea level, and are converted here by assuming they are 5 feet above mean low water.

Gamma logs are often used to distinguish between clay and silica-sand beds on the basis of the usually higher gamma count rates in clay. The usually higher count rates result from the potassium-40 isotope often found in abundance in clays, as opposed to the usually small concentrations of gamma-emitting isotopes found in silica-sand. Along the Georgia coast, however, some sand beds have high gamma count rates due to the uranium-238 isotope concentrated in phosphates and phosphorites that are deposited with the silica.

The high count rates shown in the Rayland well at altitudes -280, -390, and -450 feet are due to phosphatic sand. However, above altitude -70 feet most zones of higher count rates correspond to strata that ABB describe as clay, and the lower count rates correspond to their descriptions of sand. Therefore, the relationship of higher count rates in clays is assumed for the sections of the gamma logs shown in figure 1 from ground level to the obvious phosphatic sand unit at altitude -280 feet. A low concentration of gamma-emitting isotopes accounts for the very low gamma count rates in the limestone of the upper part of the Floridan aquifer.

The gamma log of the Rayland well illustrates the following. The top of the upper Floridan aquifer is at altitude -452 feet, which corresponds to a depth of 481 feet below ground level (BGL). The top of the Miocene unit corresponds to the top of the Hawthorn Formation in Georgia (Clarke and others, 1990, plate 1), and is at altitude -155 feet (185 feet BGL). Relatively higher gamma counts at altitude -75 feet (105 feet BGL) may represent a confining bed that is evidently continuous to the Navy#2 well at altitude -91 feet, and to the Jiffy well at altitude -100 feet. The relatively higher gamma counts at altitude -35 feet (65 feet BGL) could also represent a clayey confining bed, and possible local restriction to flow at site 11. This bed at altitude -35 feet is called "local" because it is not apparent at the Navy#2 well, and may or may not, correspond to strata with higher count rates at the Jiffy well.

ABB estimates the position of the lower "regional" confining bed, which they interpret to be the top of the Hawthorn Formation, at site 11 to be at depth 92 to 93.5 feet at well 11-3C (Technical Memorandum of Field Program, July 1994, p. 4-14). This estimate is evidently based on the analysis of one core sample from well 11-3C.

The top of the Hawthorn Formation is determined by stratigraphic correlations, and is defined as the top of the Miocene unit on the south Georgia coast. The top of the Hawthorn Formation is about 100 feet deeper (fig. 1) than the approximate 92-foot depth described by ABB (Technical Memorandum of Field Program, July 1994, p. 4-14), or the approximate 80-foot depth described by ABB later in the same report (p. 5-1).

The term "surficial aquifer" is vague, is used differently by different authors, and the lower boundary of this aquifer might be defined on the basis of very local flow conditions. The bottom of the local aquifer in the area of Kings Bay site 11, as interpreted by the USGS from logs of the Rayland well, is probably above depth 105 feet. ABB estimates the depth at between 80 and 92 feet. However, USGS interpretation of water-level data collected by ABB in January 1994 indicate a restriction to vertical flow at a depth of about 65 feet. Whether or not this restriction to vertical flow constitutes the base of a "surficial aquifer" is conjecture. The restriction may mean, however, that most flow from the site 11 landfill could be at depths of less than about 65 feet.

The gradients in the vertical at the site 11 well clusters (fig. 2) were computed by taking the ratio of hydraulic head difference (upper value at each interval shown) to thickness of aquifer over which the head difference is measured (lower value at each interval shown). The upper aquifer thicknesses were taken from the water table (assumed to be the shallowest water-level measurement) to the mid-points of the upper well screens. The lower aquifer thicknesses were taken between the mid-points of the well screens. At two-well clusters, the head loss between the shallower water-level measurement and the position of the shallower well screen was assumed to be zero.

Heads at all well clusters decreased with depth, indicating a downward component of flow. An approximate 3- to 5-fold increase in head gradients is apparent below altitude of about -35 feet, as summarized in table 1. The increased gradients indicate increased resistance to ground-water flow.

Table 1. Gradients in vertical at well clusters.

Well cluster	Gradient in vertical, above altitude -35 feet	Gradient in vertical, below altitude -35 feet
11-03	0.011	0.12
11-08	0.033*	--
11-10	0.018	0.067
11-11	0.0029	0.066
11-13	--	0.061
11-17	0.0018	0.061
11-19	0.011**	--
11-22	0.011***	--

*Total head loss of 1.64 feet over two intervals of total difference 49.49 feet.

**Head loss of 0.70 feet over two intervals of total difference 62.3 feet. The -39.0-foot mid-point of lower screen in this two-well clusteris below the -35-foot altitude limit, but water levels probably represent flow mostly above -35 feet.

***Head loss from water table to mid-point of screen in shallow well assumed to be zero.

The gradients in the vertical are combined with summaries of ABB soil-sample descriptions, and with USGS interpretations of lithology from gamma logs at the Rayland well (fig. 3). "Summaries" mean that beds described by ABB (Technical Memorandum of Field Program, July 1994, appendix A) of less than about 2-foot thickness are not shown. Lithologic descriptions for samples from most well clusters show a change from sand to clay-sand interbeds, or to clay beds, below an altitude of about -35 feet. The clay-sand interbeds and clay beds probably cause the increase in hydraulic gradient in the vertical.

The remainder of this enclosure consists of a few review comments pertaining to the ABB reports Interim Measure Activities (July 1994) and the Technical Memorandum of Field Program (July 1994).

The ground-level altitude at well PS-4 is given as 35.32 feet in the Interim Measure Activities (July 1994, Table 2-2). However, a letter to the USGS from Frank Cater of ABB, dated January 6, 1994, included surveyor's data in which the ground-level altitude was given as 36.32 feet. Which value is in error? Are other measurements referenced to the ground-level altitude given here? The USGS altitude measurement of 36.80 at the top of the PS-4 well casing (see USGS letter to David Driggers dated March 28,1994) is close to the 36.91 given for the top of the casing in table 2-2, but the USGS did not measure the ground-level altitude at this site.

The summary section of the Interim Measure Activities (July 1994), page 5-1, fifth paragraph, contains the statements that the October 1993 pumping test data indicate that the upper part of the surficial aquifer is "hydraulically isolated" from the lower part, and that the upper part of the surficial aquifer is more permeable than the lower part. Differences in permeability or hydraulic "isolation" of zones in the surficial aquifer are not apparent from either the October 1993 or March 1994 aquifer-test data. On what specific test data are these statements based? The water-level data in the Technical Memorandum of Field Program (July 1994) report do, however, indicate some restriction to flow at altitude -35 feet.

The Technical Memorandum of Field Program (July 1994, p. 2-2, table 2-1) shows the boring at the PS-10 site as 75 feet deep. However, PS-10 is called a shallow boring on the middle of page 2-6 of this report and is shown as having a boring depth of 35 feet on p. 2-5, table 2-2, of the Interim Measure Activities (July 1994) report. Is table 2-1 in error, or was this hole backfilled for 40 feet before well completion?

The statement is made in the third paragraph, p. 4-14 of the Technical Memorandum of Field Program (July 1994), that VOC's appear to migrate more easily in "this interval" of the surficial hydrologic unit. Two intervals are discussed; 25-27 and 37-39 feet. Which interval is referred to? Or does this mean both intervals? The last sentence in this paragraph states that total organic carbon decreases downward in the surficial hydrologic unit. This last statement evidently contradicts the earlier statements in the paragraph about increase in grain-size distribution (and permeability?) with depth, and the reader is uncertain as to why the statement is made.

No analytical presentation is given to support comments made in the third paragraph of page 4-14. Grain-size analysis from only one core is discussed in the previous paragraphs on this page, and no pattern of distribution is apparent from table 4-4 on grain-size data. Moreover, changes in VOC distribution with depth are not apparent from the chemical-data tables on the following several pages. A comprehensive presentation pertaining to the statements made in the third paragraph of page 4-14, referenced to specific field data, would have been helpful to the reader.

References

ABB Environmental Services, July 1994, Technical memorandum, 1993 field program and January 1994 groundwater sampling event for site 11, old Camden County landfill: Unpublished manuscript.

ABB Environmental Services, July 1994, Interim measure, phase 1 activities: system installation, technical memorandum, site 11, old Camden County landfill: Unpublished manuscript.

Clarke, J.S., Hacke, C.M., and Peck, M.F., 1990, Geology and ground-water resources of the coastal area of Georgia: Georgia Geologic Survey Bulletin 113, 106 p.

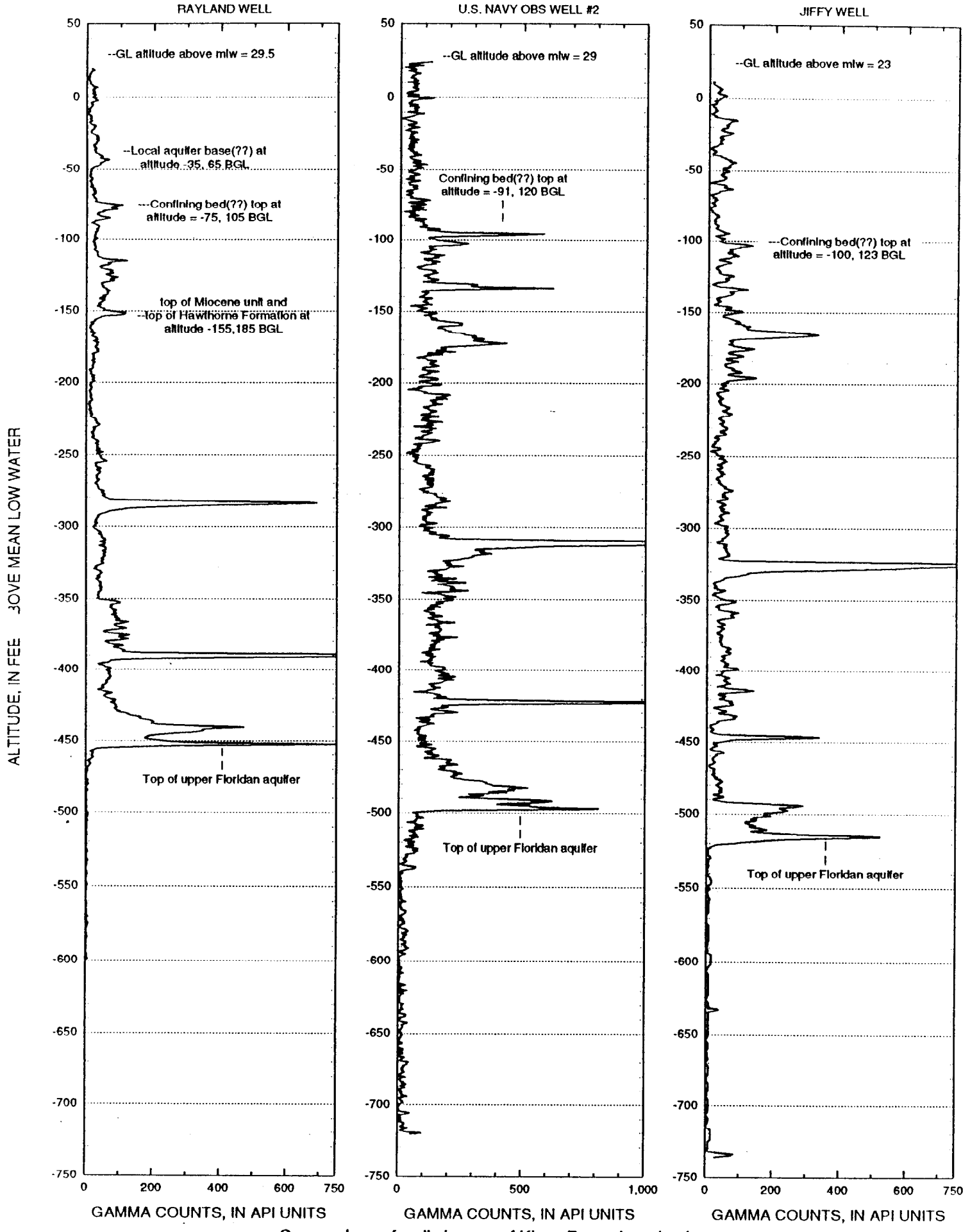

Figure 1. Gamma logs of wells in area of Kings Bay submarine base.

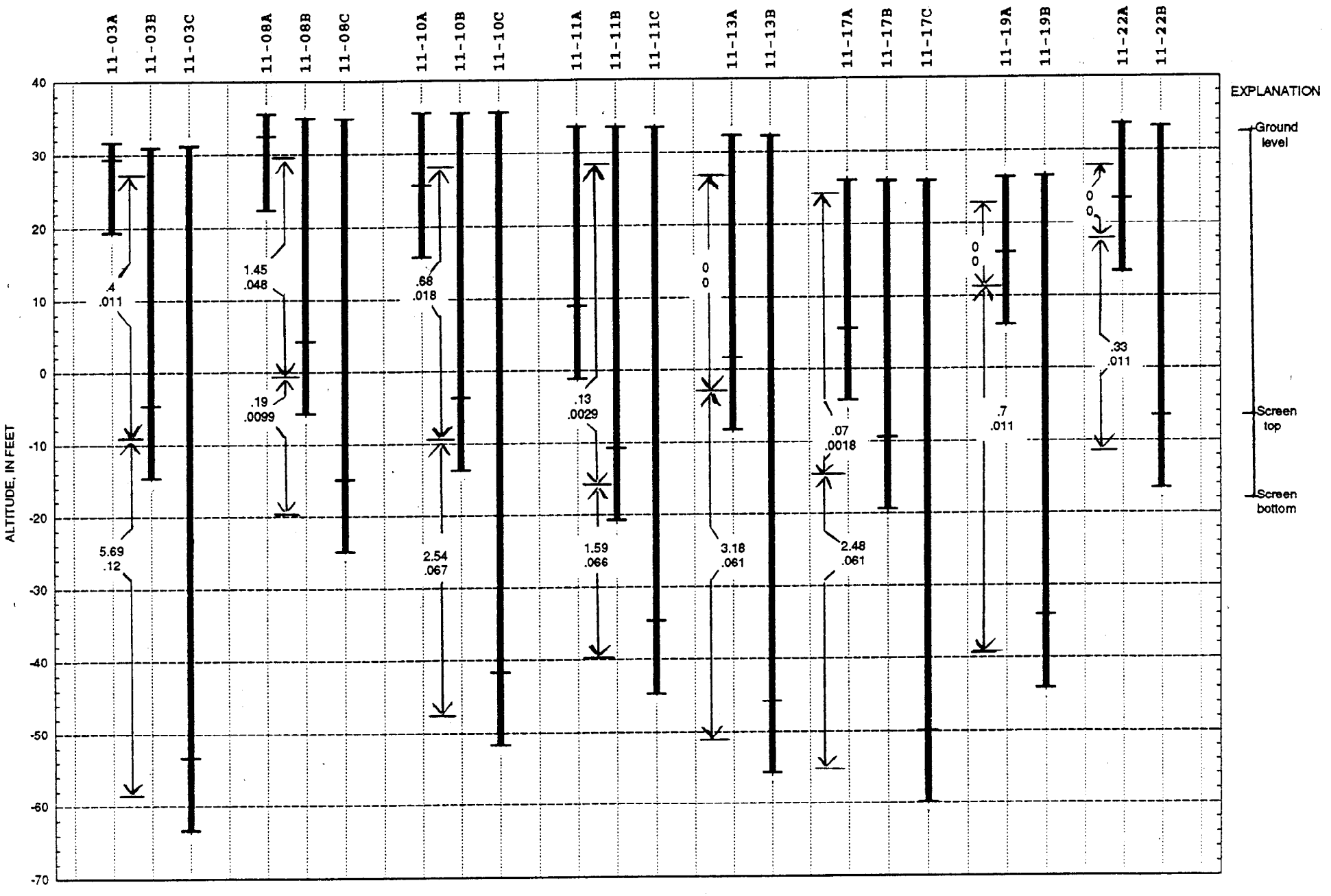

Figure 2. Hydraulic gradient in vertical at well clusters, Kings Bay Navy Base. Well construction and water-level data from ABB report, July 1994. Upper number is hydraulic head difference at each well in a cluster, and lower number is gradient of vertical flow component through indicated interval.

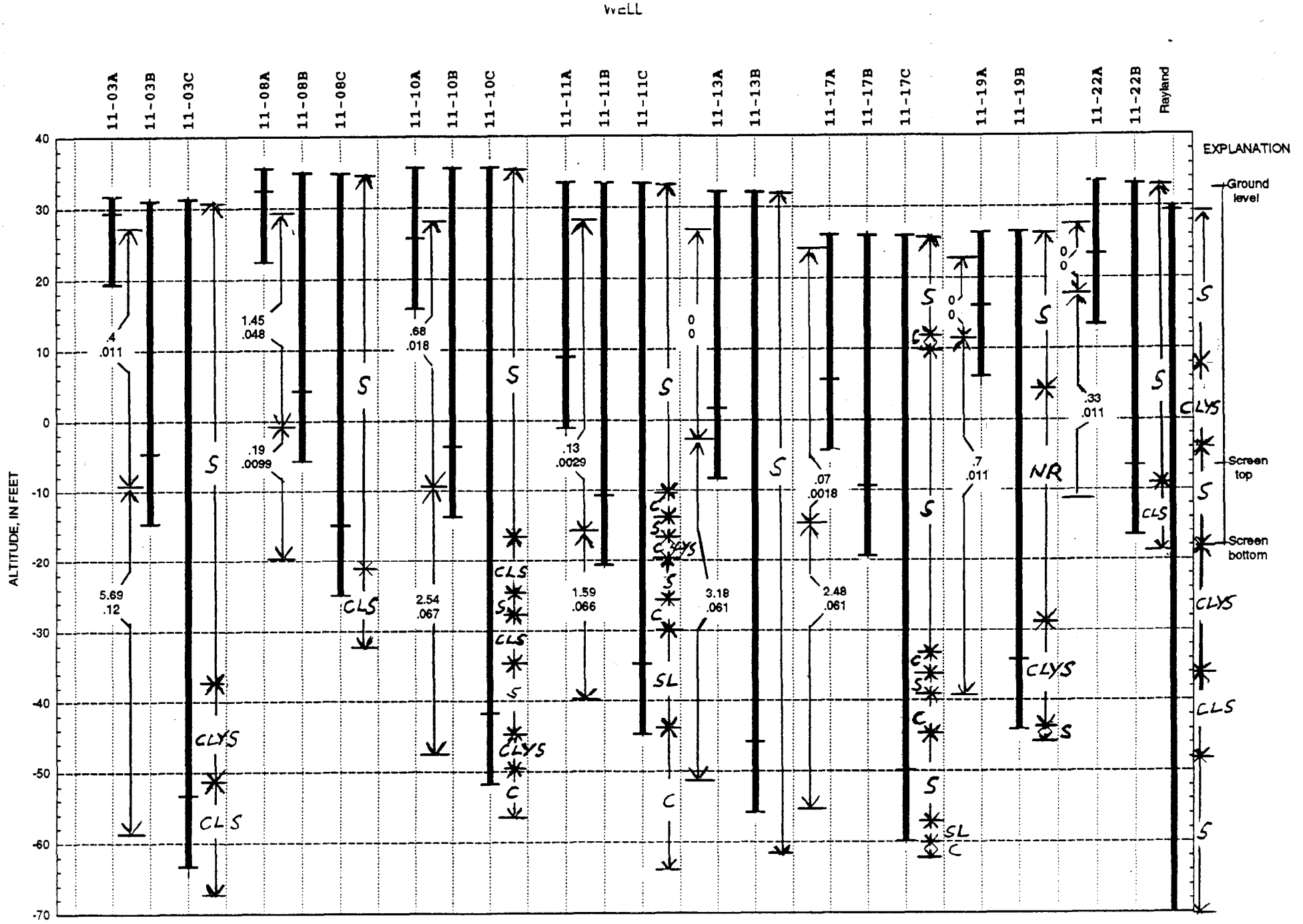

Figure 3. Hydraulic gradient in vertical at well clusters, Kings Bay Navy Base. Well construction and water-level data from ABB report, July 1994. Upper number is hydraulic head difference at each well in a cluster, and lower number is gradient of vertical flow component through indicated interval. S is sand, CLYS is clayey sand, CLS is clay and sand (as interbeds, or as higher clay content than CLYS), CL is clay, SL is sand and limestone, and NR is no record.